

# Research and Development Overview



Neil Mastin, PE  
Research and Development Manager  
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RESEARCH & DEVELOPMENT

# Research and Development Functions

- Develop an Annual Research Program funded by SP&R
- Provide implementation support for business units
- Rapid turnaround, 80 hour Technical Assistance
- Distribute research results locally and nationally
- Research Library services
- Engage NCDOT personnel in national research programs (e.g. NCHRP, Pooled Fund, SHRP, LTPP)
- Provide Research Management Services for other business units working with Universities



# Annual Research Program

- Match NCDOT research needs with expertise at universities and transportation research centers
- Initiate ~**20 - 25** new projects per year
- Manage ~**80** active research projects

**Nearly all NCDOT activities are eligible**



# FAQ

## Do the Universities decide what research will be done?

No, NCDOT does, starting with our customers ideas

## Who typically submits Research Needs to the R&D Unit?

Anyone at NCDOT

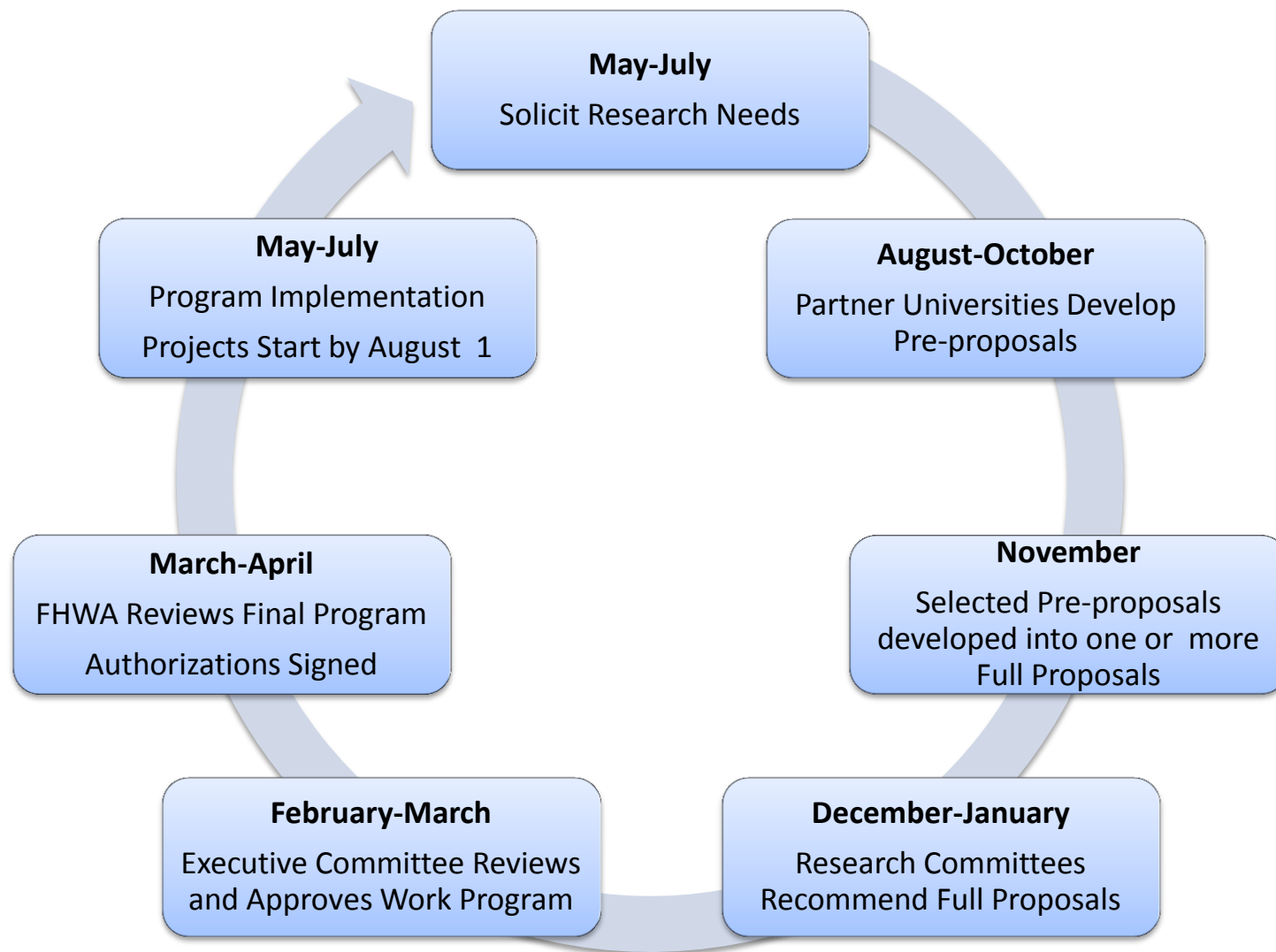
University researchers in coordination with business units

## How long does it take for an Idea to become a project?

Review and approval takes about 10 months as part of our annual Program Development process



# Research Program Annual Timeline



# Research Program Goals

Improve NCDOT Planning, Engineering and Business Practices

Support NCDOT Operations and Maintenance

Conduct research that can be implemented quickly and efficiently

Develop relationships with researchers so they understand the needs and operations of NCDOT to maximize research benefits

Maintain national leadership in Research and Implementation



# Past and Present University Participants

- Appalachian State\*
- Duke
- East Carolina\*
- Elizabeth City State
- NC A&T\*
- NC Central\*
- NC State\*
- UNC-Asheville\*
- UNC-Chapel Hill\*
- UNC-Charlotte\*
- UNC-Greensboro
- UNC-Wilmington
- Indiana State\*
- Michigan State\*
- Virginia Tech\*
- Central Florida\*
- Illinois
- Auburn

\* Master Agreements

Current Research



# Research Funding Mechanisms

Federal Aid  
SPR-II Funds  
(80-20 match)

Federal  
Discretionary  
Funds  
(100 % Fed)

NCHRP Studies

AASHTO Pooled  
Fund Program

Project Funds  
for Project  
Specific Work





# National Involvement



Long-Term Pavement  
Performance Study



Pooled Fund –  
NCDOT Manager



National  
Representative



Research Advisory  
Committee  
Representative



Coordinator for  
NCHRP Pooled Funds



# Research Library Services



Completely revamped and reorganized library

Librarian provides Research Services for anyone needing information and has access to national databases

Many engineering and transportation related books and documents

Historical information to the 1920s

Board of Transportation Minutes



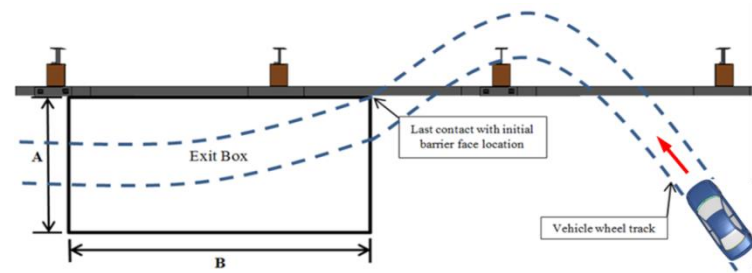
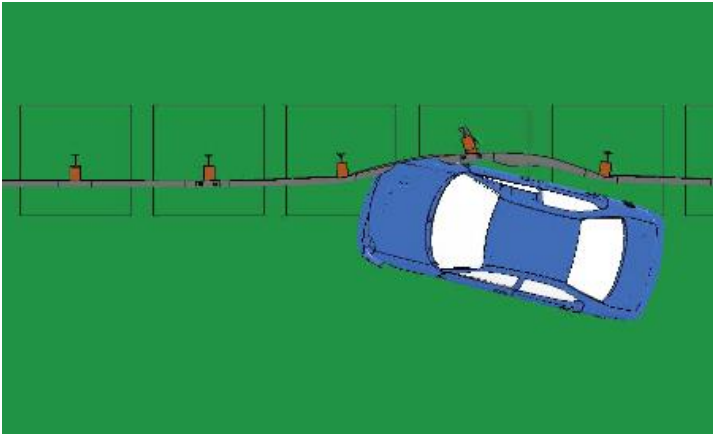
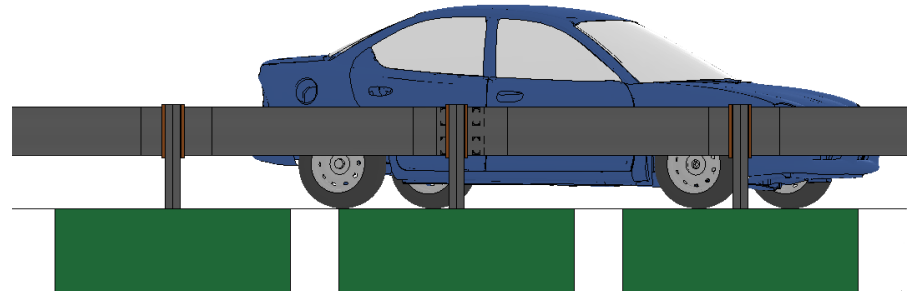
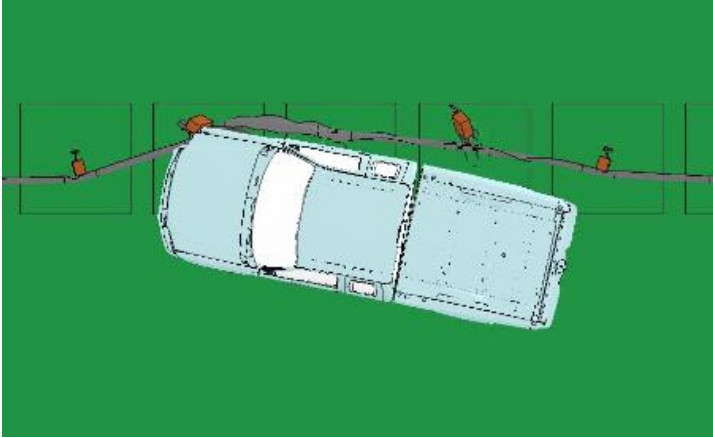
One research project can have multi-million dollar impacts in areas like network performance, safety, congestion, project selection, etc.



# Recent Successes



# Safety: Finite Element Analysis of Guardrail Vehicle Impact



Are guardrail designs safe for different types of vehicles?



# Stormwater and Roadside

- NPDES Permit Support
- Stormwater Best Management Practices Toolbox and related staff training
- Vegetative treatment of runoff
- Research that has resulted revised EPA guidelines
- Improved sediment and erosion control
- Herbicide and wildflower optimization





# Environmental Research Projects

## 2009-24, 2009-25 & 2009-26 – US 64 Improvements

Tyrrell and Dare Counties

Endangered Red Wolf Species

Eastern Black Bear

Wildlife Crossing Structures

All 3 projects included in DRAFT  
Environmental Impact Statement

Contracted with Va. Tech and  
Central Florida Univ.

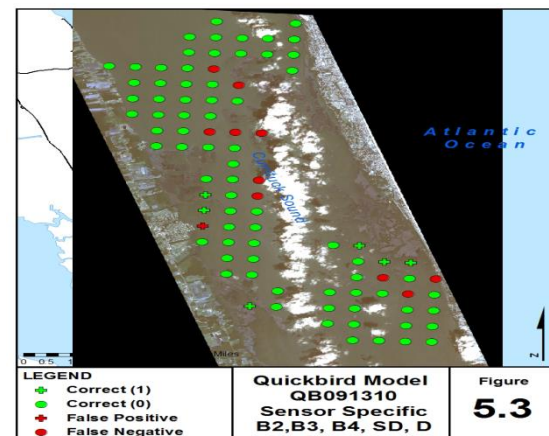
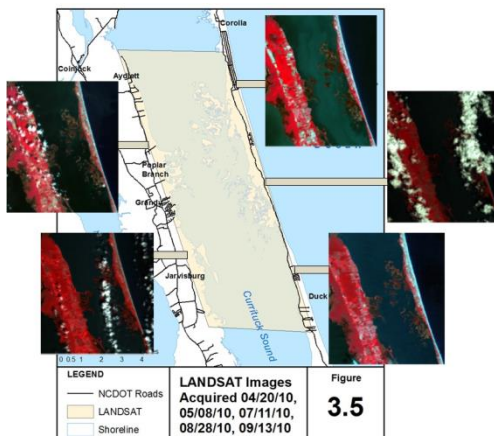
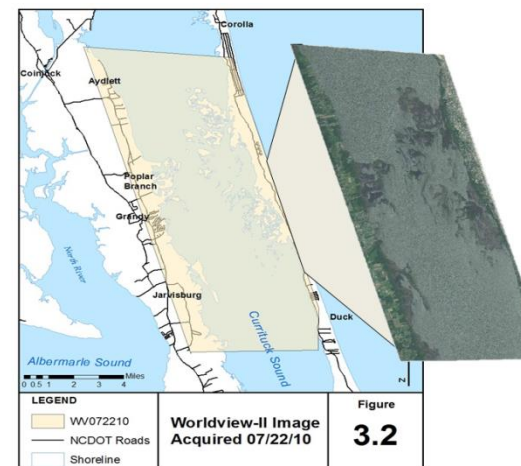
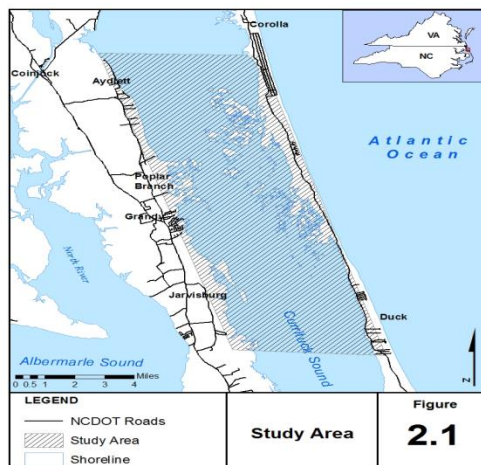


# Environmental Research Project 2010-14

NCDOT Required to Address Submerged Aquatic Vegetation (SAV)

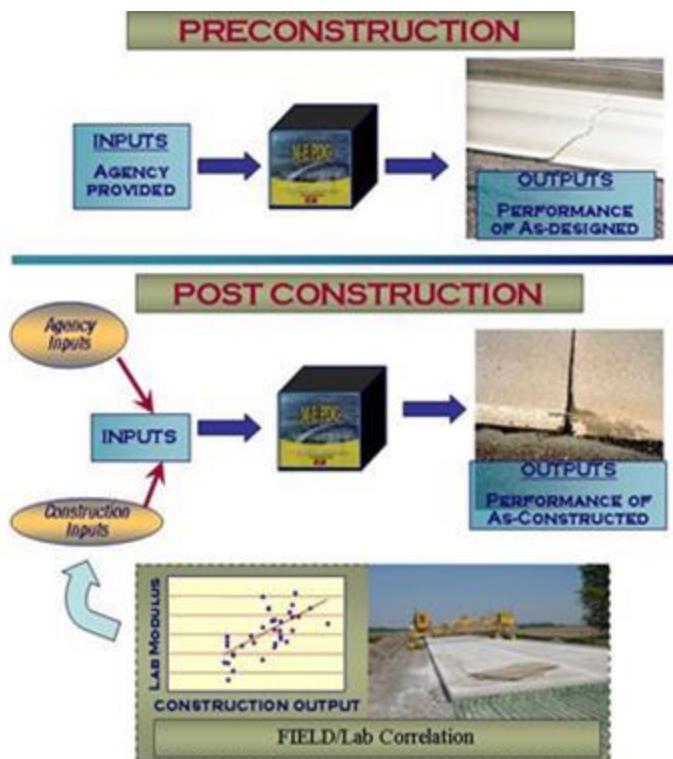
Currituck Sound in the Albemarle-Pamlico Estuary System: 13x5 Mile Area

Reduce Labor-Intensive SAV Mapping: Use High Resolution Satellite Imaging





# Pavement Management, Design and Materials



Local Calibration of the MEPDG for Flexible Pavement Design

Development of Traffic Data Input Resources for the MEPDG Process

MEPDG Inputs for Warm Mix Asphalts

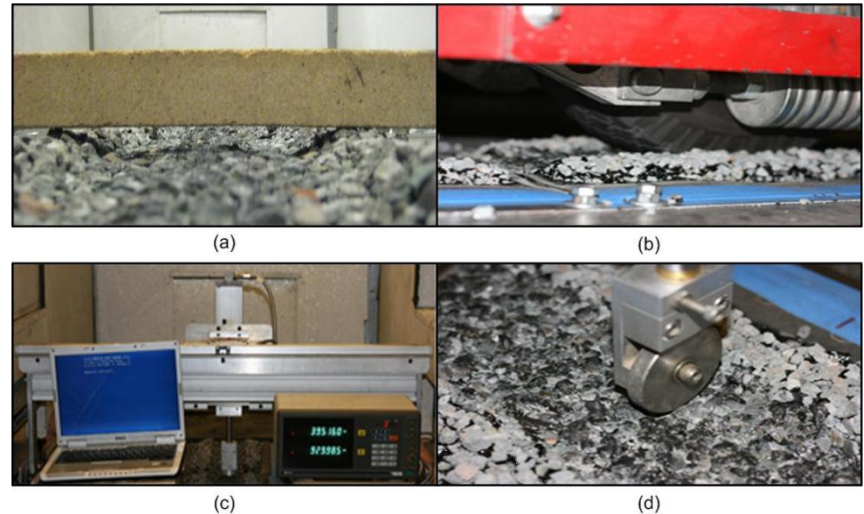
Improved Climatic Data for the MEPDG

# Pavement Management, Design and Materials

Optimizing Gradations for  
Surface Treatments

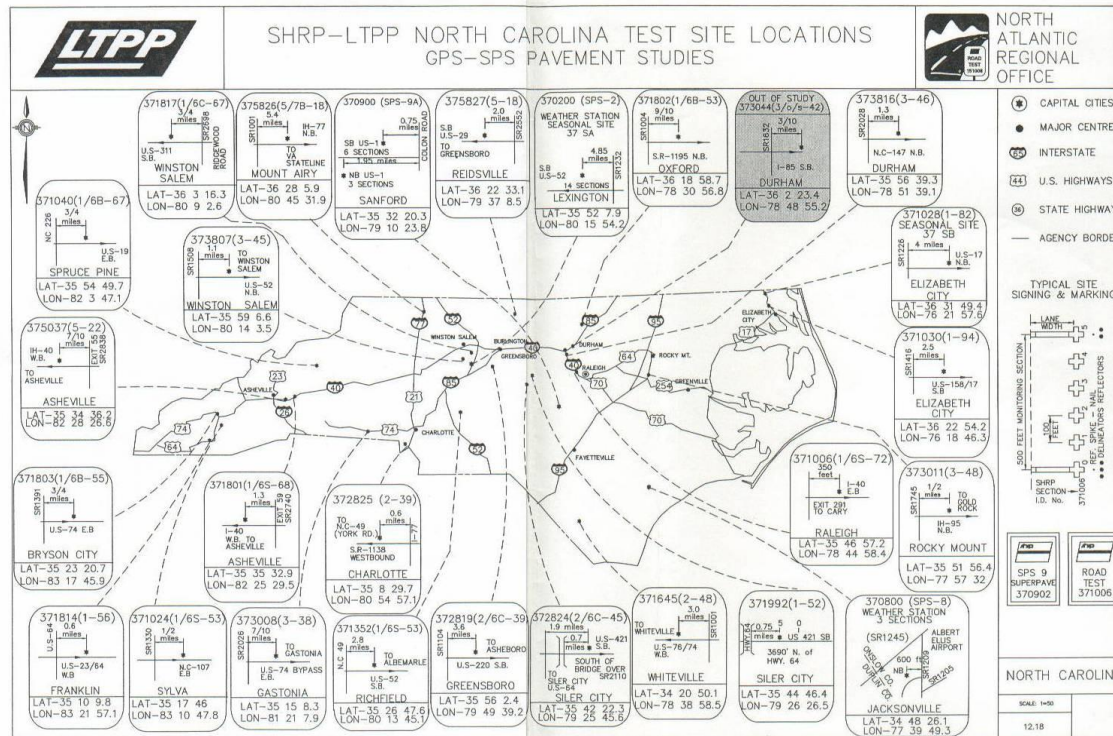
Quantifying the Benefits of  
Improved Rolling of Chip Seals

Performance-Based Analysis of  
Polymer-Modified Emulsions in  
Bituminous Surface Treatments



Seal Improvement Research

# LTPP Test Sections Across NC



50 Test Sections

27 Test Sites

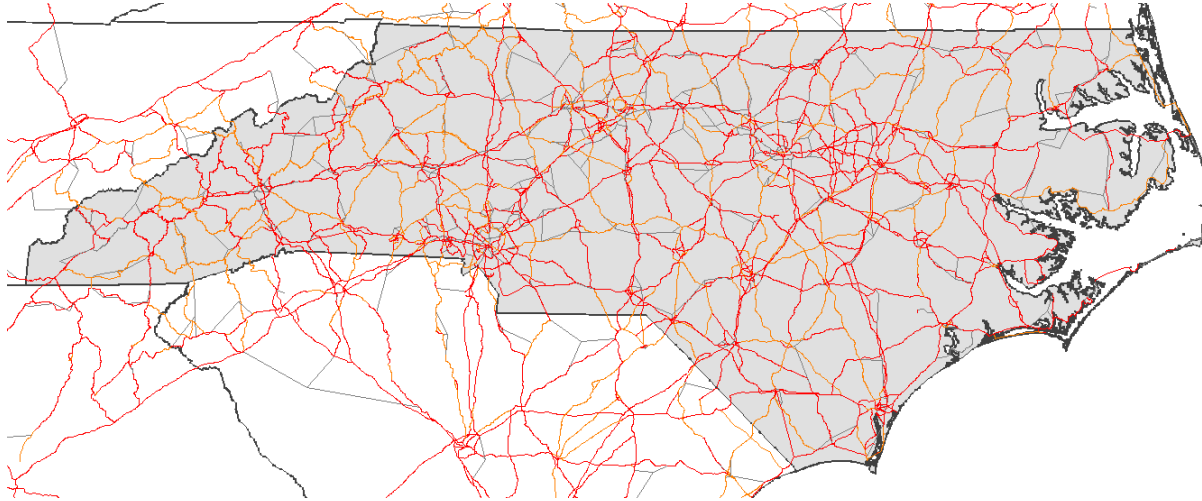
22 Counties

20 Districts

13 Divisions



# North Carolina Statewide Transportation Model



**Agile approach:** Built to incorporate future analysis “add-ons”

**Multi-Layered:** Works at national, statewide, and urban levels

**Statewide & Regional Tier Roadways** (~15,000 CL Miles)

**Simulate Truck Trips**

**2009 Base year – Future Years (2020 & 2040)**





# Research Project No. 2012-09

## Crack Free Mass Concrete Footings on Bridges in Coastal Environments

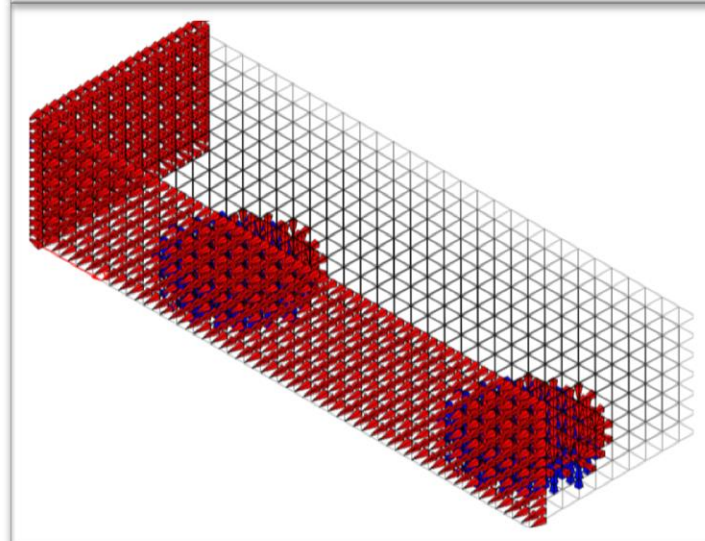
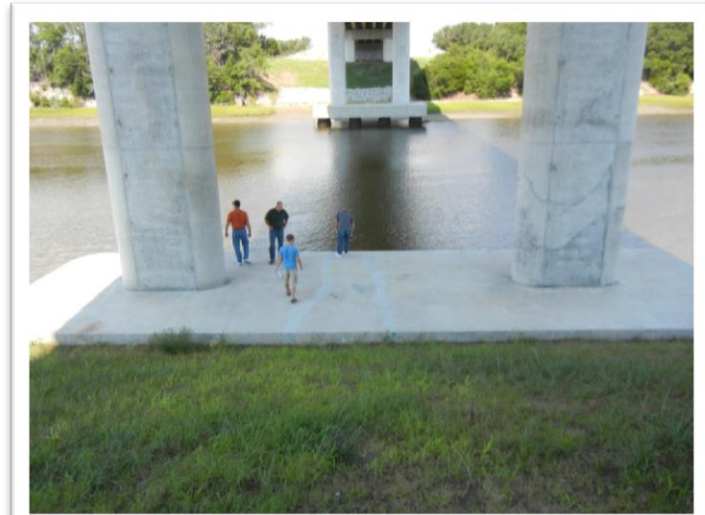
Proposed some specific additions and revisions to the current NCDOT mass concrete specifications:

Revision to material specifications allowing the use of granulated slag replacement of cement

Revision to construction methods/curing procedures

Requirement for immediate remedial actions from the contractor if the temperature differentials are exceeded

Additional requirements for Special Case “Massive” Mass Concrete (Minimum Dimension = 14 ft.):



# Research Project No. 2007-11

## Subgrade Stabilization Alternatives to Lime and Cement

Developed a computer application using a model to make predictions of subgrade temperatures and cured strength.

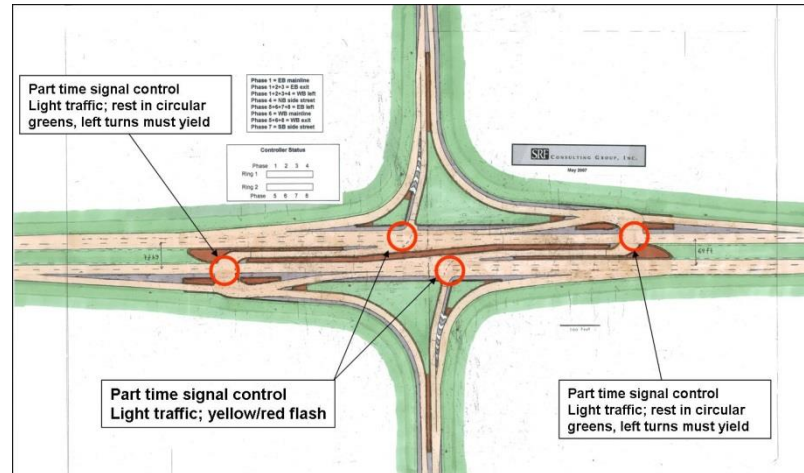
Thermal diffusivity of both lime and cement-stabilized subgrades were incorporated into a model that relates air and soil temperatures.

Software relates forecasted air temperatures to likely subgrade temperatures. May be used to inform case by case decisions as to whether cold weather exceptions can be made.

Suggests that  $\text{CaCl}_2$  modification of soil-cement is not a mature enough approach to serve as a method for mitigating the effects of low temperatures on strength gain. Additional data needed.



# Superstreet Benefits and Capacities



Superstreet outperformed the conventional intersection at each location

Reduced overall average travel time per vehicle traveling through the intersection.

Un-signalized superstreets showed a significant reduction in total, angle and right turn, and left turn collisions in all analyses.

Analyses also showed a significant reduction in fatal and injury collisions as well.





## NCDOT Research Supports Federal, State and Local Agencies





# Getting Involved

- Submit Research Needs Statements  
The Research and Development Unit is available to assist
- Review Active AASHTO and FHWA Pooled Funds. Are there any with which you'd like to be involved?  
[www.pooledfund.org](http://www.pooledfund.org)
- Submit NCHRP Proposals  
Projects that are “bigger” than North Carolina
- Targeted research and technical activities using unit funds and NCDOT Research Master Agreements with Universities  
These agreements are low overhead  
Projects can be quickly established
- Surveys: Need to explore best practices in other states? We can distribute survey requests to all 50 states + AASHTO





[jmastin@ncdot.gov](mailto:jmastin@ncdot.gov)

919-508-1865

<https://connect.ncdot.gov/projects/planning/Pages/ResearchAnalysis.aspx>

